FOREWORD

The term ergonomics stems from the Greek work *ergos*, meaning work, and *nomos*, meaning laws, which translates into laws of work. Ergonomics aims to fit the task to the human rather than that other way around. Although ergonomics has historically been used synonymously with human factors, they are becoming two distinct sciences. Ergonomics studies the physiological effects of work activities on people; human factors deals with the interaction between human beings and their work environment, which includes machines and other equipment. Applications of both can often reduce and possibly eliminate potential injuries, accommodate and enhance human performance, and provide an environment where humans and machines work seamlessly and in harmony.

The chapter, “Applied Science and Engineering: Principles of Ergonomics,” gives an overview of the history and basic tenets of ergonomics. The chapter also distinguishes between cumulative trauma disorders (CTDs) and musculoskeletal disorders (MSDs) and distinguishes the various types of ergonomic injuries. Biomechanics is also discussed, as is the lifting formula designated by NIOSH, as well as other tools for analyzing and quantifying exposures to ergonomic stressors. Steven Wiker presents the definition and scope of human factors engineering (HFE) that demonstrates the usefulness of HFE methods in preventing or reducing safety problems through improved design. HFEs work on a variety of design issues and problems that focus on human-machine-task-environment system safety. A general process for avoiding perceptual, cognitive, and motor-related design flaws is also described. Basic computations and models for use in HFE design and review are examined, and the necessity for HFE guidance in all stages of design is discussed. Lastly, sources of information for HFE design guidance are listed for further research.

Another topic which is important to safety engineers is work physiology, which is the study of physiological information about humans and how to apply that information in the evaluation and design of work. In “Applied Science and Engineering: Work Physiology,” Carter Kerk and Adam R. Piper discuss the principles of work physiology and anthropometry, applying those design principles in work design using appropriate data and allowances. Work physiology and anthropometry help the safety professional to minimize occupational injuries, while providing a safer workplace and improving productivity. Fundamental knowledge of body systems, such as the skeletal, skeletal muscular, neuromuscular, respiratory, circulatory and metabolic, are necessary in order to apply work physiology to the evaluation and design of work, which is also examined in this chapter. Also covered are aerobic and anaerobic processes, which are necessary in order to produce energy for work and prevent muscular fatigue. Evaluation of cardiovascular capacity to determine safe and effective job placement is also discussed. The obstacles to safe work design such as physical challenges, age and gender differences and work schedules (night or shift work) are also discussed, giving suggestions of ways to accommodate these differences while still increasing productivity and improving quality.

The question for most safety managers is how you assess human performance at work, which is discussed in this book in terms of benchmarking and performance criteria in Chapter 5.
The author, William Coffey, begins by examining different performance measurement systems, as well as specific metrics. Essentials for setting up an internal benchmarking system are also discussed as well as some potential pitfalls. The financial impact for companies who fail to implement ergonomics programs can be judged by examining their worker’ compensation costs, with certain caveats. Both lagging and leading metric indicators are examined, including job/task analysis. Fundamental issues such as how to define a task are discussed.

Best practices to reduce or eliminate ergonomic hazards and repetitive strains (EHRS), discussed in the last chapter, focuses on the human-machine interface using a human machine task allocation (HMTA). HMTA examines the characteristics of a tool and the human thought processes and decision-making involved in a using a tool. The OSHA guidelines for selecting tools discussed should be carefully considered when selecting hand tools. The OSHA guidelines will reduce worker strain and increase productivity.

Using a tool repeatedly to complete tasks involving limited motion frequently results in injuries termed “repetitive motion injuries.” These are the single largest type of occupational health hazard in the United States and reducing or eliminating a task proven to result in such an injury frequently requires a complete examination of a manufacturing process and its redesign. Vibration and noise from the tool can also affect worker health as well as productivity. The reasons both are of major concern and what can be done to reduce or eliminate these hazards should be well understood by safety and health managers. Any workplace environmental factor, which impacts worker performance, including poor lighting, exposure to excessive heat or cold, and workstation design all fall within the realm of human factors engineering. Understanding and addressing these factors, and others, which affect worker health and productivity, require a basic understanding of ergonomics and human factors engineering.